CHEMICAL TREATMENT LABORATORY RESULTS AND RECOMMENDATIONS FOR DEPOT SLOUGH, YAQUINA RIVER

March 1981

1. Synopsis. Sediment samples from Depot Slough underwent jar tests. These tests determine the best flocculant to use for settling sediments discharged into an upland disposal facility. Disposal facility design and flocculant application methods are presented.

SAMPLING METHODS

2. Sediment samples were obtained with a pipe sampler or a hand-driven coring pipe (table 1). The former sampler consisted of an iron pipe which is closed at one end and dragged through sediments. This method obtained surface samples only. The coring tube consisted of a 2-5/8-inch diameter cylinder of cellulose acetate butyrate (CAB) which was equipped with a stainless steel core catcher at its mouth. The corer was hand-driven into the sediments. It provided a 2-foot-long vertically stratified sediment sample.

3. Sediments were collected at four locations (figure 1). Sediments obtained with a pipe sampler were stored in 1-gallon plastic containers and shipped to the Waterways Experiment Station for analysis (see attachment 1). The core sample was shipped in a 2-foot segment of CAB pipe which was sealed with polyethylene caps.

CONCLUSIONS

4. The jar tests indicated that Hercofloc 863 and Magnafloc 577C, were the best polymers to use to flocculate Depot Slough sediments. The Magnafloc 577C is available from:

American Cyanamid
P.O. Box 3381
Portland, OR 97208
(503-228-6281)

Hercofloc 863 is available from:

Hercules Incorporated
Water Management Chemicals
One Maritime Plaza, Golden Gate Center
Suite 1250
San Francisco, CA 94111
(415-986-2535)

TABLE 1

FIELD REPORT - DEPOT SLOUGH

Purpose of Sampling Collect samples for "jar" test to be conducted at Waterways Experiment Station

Date 26 March 1981 Wind Light

Water Conditions (Wave heights & Direction, Tides, Currents) Low tide, 1105 hours (+2.6)

Weather Overcast with periods of showers Sampling Vessel 24-foot sailboat/Port of Toledo

Sampling Personnel Stuart U'Ren, Charlie Zalmanek Sampling Gear Ellard and Core tubes

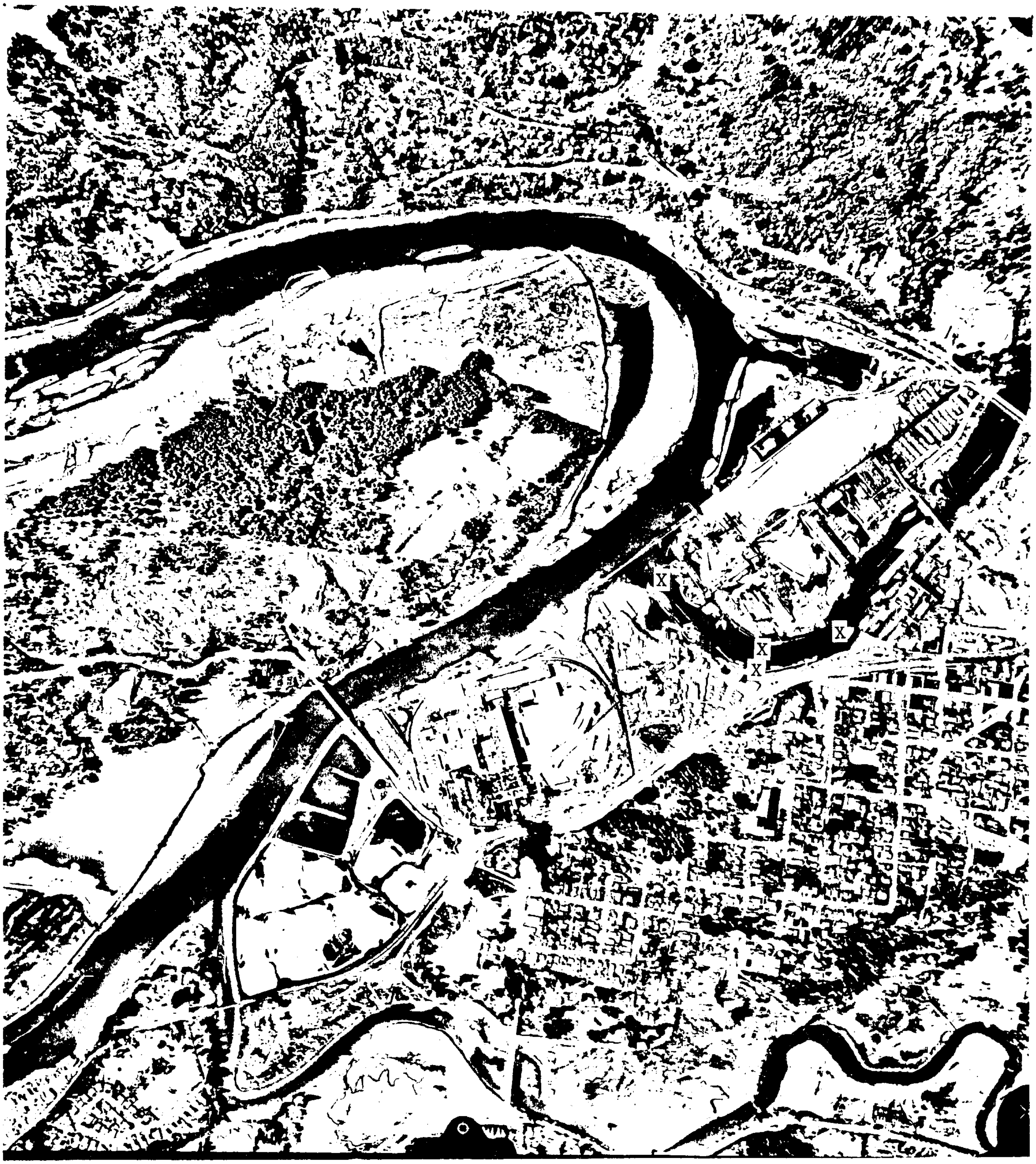
Analytical Laboratory Waterways Experiment Station - Doug Shields

Comments (Wildlife, Sampling Difficulties, etc.) Very mucky - Ellard would dig in, plug mouth and could not be moved.

Station	Depth	Sampling Time	Sampling Methodology	Sampling Description
DSRM .25	8-10'	1045	Ellard	Black muck, no sand, composite of 4 attempts- 1 gallon.
DSRM 0.1	8-10'	1100	Ellard	Same as above, decomposing leaves present - 1 gallon.
DSRM 0.02		1115	Ellard	Not quite as mucky, composite of 3 attempts - 1 gallon.
DSRM 0.1	6'	1130	Core container pushed into sediment	Muck

Conclusions (Is sampling completed? Was sampling method adequate? Considerations for future sampling at the project)

Sent samples to Waterways Experiment Station on 27 March 1981, 1030 hours.



DEPOT SLOUGH, YAQUINA RIVER

X = Sediment Sampling Locations

Figure 1

ATTACHMENT 1

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESEE

13 April 1981

U. S. Army Engineer District, Portland
ATTN: Ms. Pam Moore, Planning Division
P. O. Box 2946
Portland, OR 97208

Dear Ms. Moore:

Inclosed is the report of our work performed in response to your request for DOTS assistance (Incl 1). The report contains the jar tests results and the recommendations on chemical treatment for the Depot Slough dredging project. If you have any questions or need further assistance, please contact us.

Sincerely,

MICHAEL R. PALERMO
Engineer
Chief, Water Resources
Engineering Group

1 Incl
As stated

Chemical Treatment Laboratory Results and Recommendations for Depot Slough on the Yaquina River

DOTS Assistance for Portland District

by

Paul R. Schroeder

April 10, 1981

Environmental Laboratory
U. S. Army Engineer Waterways Experiment Station
P.O. Box 631, Vicksburg, Mississippi 39180

Chemical Treatment Laboratory Results and Recommendations for Depot Slough on the Yaquina River

DOTS Assistance for Portland District

1. Summary. Proper design and operation of the dredged material containment area and weir structure is required to maintain good effluent quality and to minimize the required polymer dosage. The results of our jar tests showed that 2 mg/ℓ of polymer added at the primary weir would be an adequate dosage to achieve an effluent suspended solids concentration of 100 mg/ℓ and an effluent turbidity of 50 NTU's if the primary basin was properly designed and sufficient mixing was provided. Without provisions to insure adequate mixing, up to 6 mg/ℓ of polymer would be needed. If the primary basin has inadequate storage volume or detention time, the required dosages will be much higher, 7 or more mg/ℓ with good mixing conditions and 12 or more mg/ℓ with poor mixing. These higher dosages would also be needed if the weir length was undersized. The best polymers were Hercofloc 863 and Magnafloc 577C. Hero-floc 863 is less expensive and only slightly less effective. Four barrels of polymer, 2000 pounds, is required for the project. The cost of the polymer will be about $1400. Due to the small size of the project, we recommend a gravity feed system for diluted polymer at the primary weir box. The culvert between the two containment cells should be designed to provide sufficient mixing for the polymer.

2. Purpose and Scope. The purpose of this study is to assist in the development of chemical treatment parameters for the Depot Slough dredging project. The scope of this work was to perform jar tests to determine the best polymer into the pipeline for this material, and to develop alternatives for applying chemical treatment.

3. <u>Background Data</u>: The following data were supplied by Ms. Pam Moore and Mr. Stu U'Ren of the Portland District.

Dredged material volume (in situ): 30,000 yd^3

Dredge type: 8" to 12" cutterhead

Dredge pipeline length: 500 to 4000 ft with booster pump

Disposal area size: possible 400' X 250' X (4' to 8.5') and a secondary area

Sediment characterization: organic sandy silt

Salinity: 9 to 15 ppt

Effluent criteria: turbidity, 50 NTU's above ambient

Available equipment: pumps, generator, trailer

Other: power and access are available

4. <u>Jar Tests</u>: Four polymers, all proven performers on dredged material, were applied to 2 g/ℓ suspensions composed of grab samples from the upper, middle and lower reaches of the dredging project. The four polymers were Calgon M-502, Nalco 7103, Magnafloc 577C and Hercofloc 863. The mixing conditions and settling time were controlled to closely approximate the assumed field conditions. Following this screening of polymers, we performed several additional tests with the best polymer, Hercofloc 863. We examined the performance of Hercofloc 863 with improved mixing conditions similar to those resulting from a drainage structure modified to achieve better mixing between the two basins. We also examined the clarification of a 0.5 g/ℓ suspension of the grab samples under normal and improved field mixing conditions. Finally, we checked the effectiveness of Hercofloc 863 on a 3 g/ℓ suspension prepared from a core sample taken at the middle reach of the dredging project.

5. <u>Jar Tests Results</u>: Based on achieving a turbidity of 50 NTU's and a suspended solids concentration of 100 mg/ℓ at minimum cost, the best polymer was Hercofloc 863. Magnafloc 577C was slightly more effective but it is more expensive. The dosages of Hercofloc 863 required to meet the effluent quality listed above under the various jar test conditions are shown in the following table.

REQUIRED HERCOFLOC 863 DOSAGE

Sample	Normal Mixing (Gt=2000)*	Improved Mixing (Gt=5000)*
0.5 g/ℓ Grab Sample	6 mg/ℓ	2 mg/ℓ
2 g/ℓ Grab Sample	12 mg/ℓ	7 mg/ℓ
3 g/ℓ Core Sample	14 mg/	

*Gt = nondimensional product of mixing intensity and duration of mixing; related to the energy applied for mixing per unit volume.

6. <u>Pipeline Injection</u>: Preliminary tests to determine the polymer dosage required to apply the polymer in the dredge pipeline indicated that excessive dosages would be required. Consequently, further tests were not conducted. The required dosage would be near 500 mg/ℓ. Therefore, pipeline injection was judged to be too expensive to be feasible.

7. <u>Weir Length</u>: The concentration of the dredged material suspension to be treated at the primary weir is strongly dependent on the weir length and ponding depth (see Technical Report D-78-18). To achieve a good effluent quality, I recommend that the area be operated so as to maintain as much ponded water as practical during dredging and that the weir be designed for a weir loading of 0.4 cfs/ft of weir length.

8. Secondary Basin Size: The secondary basin must be designed to supply sufficient settling time. A theoretical detention time of two to three hours should be sufficient for a basin with a length to width ratio greater than 2.5. Volume must also be provided for the settled material.

9. Mixing: Good mixing is needed to achieve sufficient contact between the polymer and the dredged material particles. Sufficient mixing can be obtained from the turbulence in the culvert between the two basins if sufficient head loss and detention can be achieved in the pipeline. One method of mixing would be to install a static mixer in a long culvert. A second method would be to use multiple, long, small-diameter corrugated pipes. In both cases, care must be taken to control the head loss within the site constraints. Also, gratings would be needed before the pipe inlet to prevent clogging the pipe. Below are several examples of possible corrugated pipe designs which would carry the required flow with a head loss of about one foot. In almost all cases the longer pipe produces the best mixing.

Example Drainage Structure Designs

Number of Pipes	Diameter (inches)	Length (ft)	Mixing, Gt
8" dredge			
4	12	100	10200
2	15	100	9130
3	12	60	6800
1	18	50	5000
10" dredge			
2	18	100	8780
1	24	100	7810
3	15	80	7640
5	12	70	7640

12" dredge

3	18	100	8780
2	21	100	8250
4	15	65	6520
1	27	75	5800

Optimum mixing for polymer-particle contact requires a Gt of about 25000; though, a Gt of about 8000 provides adequate mixing. If more head loss was allowable, static mixers (baffles) could improve the mixing without using extremely long pipes. Without sufficient head available for mixing, mechanical mixers would be needed.

10. Polymer Feed System: Due to the small size of the project, a gravity feed system may serve your needs best. The system could consist of only a large tank (500 to 1000 gallons), a portable pump for dilution water, a pipe or hose to run from the tank to the weir box, a simple nozzle or sprayer to distribute the polymer for better mixing, and a valve to control the flow rate. Alternatively, a small tank truck could be used instead of a pump and a tank. This would be simpler because you could dilute the polymer in advance. You could also haul in diluted polymer with a small tank truck. Diluting the polymer by a factor of 50 would facilitate mixing in the culvert. The total volume of diluted polymer required will probably not exceed 10,000 gallons and may be as low as 3500 gallons.

11. Costs: The polymer costs about 70 cents per pound in lots of this size. The total polymer needs should not exceed 2000 pounds or four 55-gallon drums. The total cost would be approximately $1400. The labor requirements should be small for this simple system. Labor requirements will also be minimal since the production time should not exceed four days. The equipment costs should

be fairly low since all this is required for the pre-mixed gravity feed system is hoses or pipe, a valve, a nozzle and truck rental.